

THE ANALYST.

MARCH, 1894.

PROCEEDINGS OF THE SOCIETY OF PUBLIC ANALYSTS.

THE usual Monthly Meeting of this Society was held on February 7th at the rooms of the Chemical Society, Burlington House. In the absence of the President, Mr. Otto Hehner occupied the chair.

The minutes of the last meeting were read and confirmed.

The following gentlemen were proposed as members: Leonard Archbutt, F.I.C., 11, Charnwood Street, Derby; B. E. R. Newlands, 27, Mincing Lane, E.C.; T. H. Pearmain, Apothecaries' Hall, Blackfriars, E.C. As associate: Raymond Ross, Assistant to Dr. Horace Swete.

The following gentlemen were duly elected members: Frederick Dunn, James Edmunds, M.D., A. R. Ling.

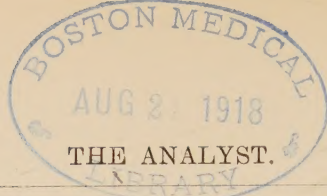
Papers were then read on "The Detection of Cotton-seed Oil in Lard," by Edward J. Bevan; "Milk and Milk Products," by H. Droop Richmond; and on a "Suggested Addition to Richmond's Milk Scale," by Walter J. Sykes. The publication of these is unavoidably held over.

PRESIDENT'S ANNUAL ADDRESS.

(*Delivered at the Annual Meeting, January 24th, 1894.*)

GENTLEMEN,—My first and most pleasing duty is to thank you most heartily for the great compliment which you have paid me by re-electing me as your President for a second year. Some of you are aware that I was anxious to have a successor appointed at the expiration of my first year of office, because I feel that I have not been able to discharge the duties of a President even in a perfunctory manner. Living as I do at so great a distance from our headquarters, and having but little natural capacity to encounter the "horrors of the Channel passage," are my excuses for being an absentee President. My remorse would, however, have been greater than it is had I not been cheered by the reflection that my good friend the immediate past President, Mr. Otto Hehner, had kindly promised to be always present at your meetings and to preside in my absence, if you were willing that he should, which I venture to think was always the case.

Everyone must naturally feel some pride in being placed *primus inter pares*. I assure you that I feel very deeply the honour of being for the time the official head of a profession with which I have been intimately associated almost since the days of my boyhood. During my long and busy life, I have devoted no inconsiderable



proportion of my time to professorial and medical work, yet I have always regarded myself as being primarily and chiefly an analytical chemist. I have indeed lived through the period in which chemical analysis has been formed into a distinct profession. When I was a student, commercial analytical work was almost completely carried on in the laboratories of professors and lecturers. Except in London and a very few other large towns, there were no chemists who exclusively devoted themselves to analysis for technical and commercial purposes. The importation of guano and the establishment of artificial-manure works—events occurring towards the middle of the century—gave a great impetus to the development of chemical analysis into a distinct profession. For a time the examination of fertilizers was conducted in laboratories not connected with works, but very soon the larger artificial-manure manufactories began to secure the exclusive services of analysts. Then it became the practice to subject much more largely than formerly all sorts of things to analysis for commercial purposes—nitre, nitrate of soda, oil-cakes, ores, soils, kelp, drugs, etc., were appraised chemically. The next epoch was the passing of the Act relating to adulteration of food and drugs in 1860. This measure, however, created but little demand for analytical work, and very few public analysts were appointed under its provisions. Dr. Hill, of Birmingham, and myself are the only survivors of the few analysts which the Act of 1860 called into existence. In 1872 a more effective Adulteration Act was passed, and it led to the immediate appointment of a large number of analysts. The sudden demand for them could not be properly met, and no doubt at first many persons were appointed as official analysts who had not the proper qualifications for such a position. It is probable that the somewhat low estimation in which the public analysts were held by the professors of chemistry and the chemists engaged in original research was due to the fact that many of the former were well known to be persons who had no real claim to the designation of either a theoretical or practical chemist. The extremely small salaries which the majority of them received were not likely to elevate them in the estimation of the university and college professors.

Shortly after the passing of the first Adulteration Act greatly increased attention was given to the subject of public health. Year by year sanitary statutes were enacted, and in process of time thousands of medical officers of health were appointed. The analysis of water used for potable purposes now began to be carried out upon a gigantic scale, and although some of the work was performed by the medical officers themselves, by far the larger proportion of it devolved upon the analysts.

It seems pretty clear, then, that it is chiefly to the use of fertilizers and feeding-stuffs, and to the passing of the Acts relating to adulteration and public health, that we are indebted for the creation of the distinct profession of the analytical chemist in these countries. They still furnish the greater portion of material for our work, but steadily the demand upon the skill of the analyst is extending from every direction. There will soon be hardly a commercial article that will not be bought or sold on the certificate of the analyst.

Having thus briefly surveyed the progress which the profession of chemical analyst has made during the last half century, let us now examine into our present position and our prospects.

The analysts of the present day are in status far in advance of their predecessors of twenty years ago. A large proportion of the public analysts originally appointed have disappeared, and their place is now occupied by much more competent persons. The emoluments of the analyst have increased, chiefly because the amount of work has been enormously augmented. The teaching of analytical chemistry, based upon the general principles of chemical science, is now carried on in most of our large towns, and the laboratories of the leading analysts are excellent practical schools for the younger chemists. Science is so vast that we have to subdivide it, so that our finite understandings may be able to grasp even an almost infinitesimal portion of it. Chemistry, itself a fragment of science, cannot by any one mind be studied as a whole; and surely that department of it which relates to the analysis of bodies must be sufficient to afford sole occupation for even the most intelligent mind. The processes of analysis are so numerous, the number of distinct articles to be examined so large, that there seems to be even a necessity for chemists to devote themselves altogether to special departments of analysis, as indeed many of them do at present.

It is pleasant to be able to affirm, without fear of contradiction, that the professional status of the chemical analyst is now fully equal to that of the great majority of the other professions. The training required in order to qualify him for his calling involves an amount of intellectual exertion quite equal to that necessary to attain the position of a barrister or an engineer. The proportion of our professional brethren who proceed to university degrees in arts and science is steadily increasing, and the day I believe is not distant when no one can be appointed to any official position as an analyst who has not passed a qualifying examination for such a situation. Both branches of the legal profession are regulated by law, and no one can practise either without having gone through a prescribed course of instruction and passed examinations. Medical men, dentists, pharmaceutical chemists, and even druggists, who merely sell drugs, have all to pass examinations qualifying them to practise. The plumbers are demanding an Act of Parliament to establish the principle of examining and registering the members of that handicraft. It is clear, then, that the time has arrived for seriously considering the question of the registration of chemical analysts.

It may be said that the Institute of Chemistry affords the machinery for testing the knowledge of chemical students, and for giving those found to be worthy of it the title of Fellow or Associate. Those titles have not, however, as yet been recognised in the same way as those conferred by the legal and medical corporations and other bodies, such as the Pharmaceutical Society. They confer no exclusive privileges. A person who has no chemical title or degree, or diploma in science, may be legally appointed an official analyst. My predecessor, Mr. Hehner, has insisted upon the importance of testing the competency of candidates for the office of public analyst by obliging them to obtain diplomas, and he suggests that our Society would be the proper body to grant such a diploma. I was at first averse to this proposal, because I feared that the Institute of Chemistry might regard it as an interference with their functions as an examining body; but I confess that I have now come to the conclusion that the proposal has much to recommend it, and that it ought at least to be seriously considered. If our Society ever comes to the determination to establish the diploma

of analytical chemist, I trust that the examinations for it may be of the most comprehensive and stringent nature, and that it should not be conferred upon anyone, no matter how eminent as an analyst, who was unwilling to submit to the test of examination. Supposing at some future time that a chemical diploma became a *sine qua non* for a chemical appointment, it might be said that it would not be fair to disqualify an analyst who had no diploma, but whose record proved his competency. This difficulty might be got over by providing that persons who had held official positions as analysts up to a certain date should be eligible. One of the provisions of the last Medical Act declares that no person shall be appointed medical officer of health for any town containing more than 50,000 inhabitants who does not possess a degree or diploma in public health or State medicine, except he has already acted as a medical officer of health for a large town.

The question as to the minimal amount of certain constituents of articles of food, drink, and drugs which should be permitted to pass unchallenged, is one which imperatively requires to be answered in no uncertain voice. The "battle of the standards" is being incessantly waged, not only between the analysts and the vendors of food and drink, but between analysts and analysts. The Legislature has defined the strength of the stronger alcoholic liquors, below which the latter must be regarded as adulterated, unless the strength be declared before purchase. The Legislature should fix similar standards for other articles, particularly beer, milk, buttermilk, cream, butter, cheese, and vinegar. The amount of rectified and proof spirit in tinctures and other drugs might be defined, and perhaps also the amounts of solid matter held in solution. In prosecutions in cases of deficiency of alcohol in tinctures the excuse is invariably set up that the deficiency is due to evaporation during the process of manufacture or during storage.

The maximal amount of water which should be permitted in butter is one which the Legislature should determine as speedily as possible. The monstrous proposition has been made that butter might legitimately contain 10 per cent. of salt and 25 per cent. of water! There are many persons of opinion that no person should be punished under the provisions of the Food and Drugs Act who did not knowingly adulterate the articles they prepared or sold. There is, however, such a thing as criminal negligence, which people have often to pay very smartly for. If a careless driver knocks down and kills or maims a person, it is no excuse that he did not intend to do so. It is quite clear that at all times of the year heavily salted and lightly salted butters are made containing from 8 to 14 per cent. of water. There is no good reason why some persons should make butter containing 20 per cent. or more of water, whilst in the same district, and under similar conditions of climate, other persons make butter containing 10 or 12 per cent. of water. The butter-maker is morally bound to take care that he produces an article of the "nature, substance, and quality" which the public expect, and ought to receive; and if he does not, he certainly deserves the very mild punishment which is permissible under the Food and Drugs Act.

Should a Bill to amend the Sale of Food and Drugs Act be introduced into Parliament, it will be necessary to include in it many amendments of the provisions

of the existing Acts. It seems to me that there is too much red-tapeism in the forms prescribed by the Acts. Many prosecutions have fallen through, for example, because the food inspectors merely informed the vendors that they intended to submit the article purchased to analysis, but did not say by the public analyst, or did not name that functionary. Surely it seems sufficient to intimate to the vendor that the inspector purchased the article with the view of ascertaining whether it was pure or adulterated.

I have known many cases to be dismissed because the articles sent for analysis by parcel post were not registered, though the Court of Queen's Bench in Ireland have unanimously declared that articles for analysis may be sent by railway—a less secure mode than by parcel post.

Over and over again magistrates have dismissed cases because no evidence was submitted showing that the analyst's signature to the certificate was genuine. The Chief Secretary to the Lord-Lieutenant for Ireland has requested the Irish public analysts to put an impressed stamp upon their certificates, in order to give them a more official and genuine appearance.

Private persons who believe that the articles which they have purchased are adulterated, find it difficult to prosecute the vendors. In all such prosecutions the attendance of the analyst appears to be requisite. Until lately prosecutions for the sale of unsound food were practically limited to cases where the articles had been seized by an inspector of nuisances or medical officer of health. The last amendment of the Public Health Act provides that a private person who has purchased an article of food which proves to be unfit for use can hand it over to the sanitary officer, and he can proceed in reference to it in the same manner as if he had himself seized it. Similarly, it might be provided that a person who had reason to believe he had bought an adulterated article could hand it over to be dealt with by the food inspector. In such case, then, the evidence of the analyst, which at present must be parole, might be given in the usual form of certificate. The inspector should, of course, hand a portion of the article to the vendor, and retain a third part for analysis, if so ordered, by the Somerset House analysts. I have had often to go to distant parts of Ireland to give evidence in adulteration cases, in which inspectors were not the prosecutors, but in which there was no sufficient reason, if the law permitted it, to prevent them from acting as such.

I have now to say a few words in reference to the work of our Society, and our losses and gains in 1893.

In a Society composed of two hundred members, many of them, like myself, "in the sere and yellow leaf," we could not expect to pass through the year without some of us paying the great debt we owe to nature. Our losses by death have, however, been comparatively small. There are few communities in which a death-rate of fifteen per thousand living would not be regarded as a small one. Ours has not exceeded that rate. But though there have been only three gaps made in our ranks in 1893, they have been in the strongest parts of our line. We have to deplore the death of Mr. C. W. Heaton, for many years our valued treasurer, and a hard-working member of our Society. His loss will be difficult to make up for. We have

also taken from us, by one of those inscrutable decrees of Providence, in the flower of his manhood, our valued friend, Mr. R. H. Davies, for three years one of our honorary secretaries. Our third loss has been in the person of Dr. H. Critchett Bartlett, who in former years was one of our most energetic members, but who for some time past had practically given up chemical work.

Owing to resignation and to unduly prolonged absence of mind in reference to annual subscriptions, 3 members and 4 associates are no longer summoned by our courteous secretaries to attend our meetings. On the other hand, we have added to our numbers 1 honorary and 17 ordinary members and 11 associates. Our Society now consists of 9 honorary members, 188 members, and 25 associates, making the respectable total of 222.

Dr. Tilden, F.R.S., President of the Institute of Chemistry, is the gentleman elected as honorary member. He deserves the highest compliment that our Society could pay him, for in him the claims of the analytical chemist have perhaps their most eloquent and earnest advocate.

The various papers read before our Society in 1893 are further evidence, were such required, of the activity of our members and their capacity for original research. Many of the papers contain matter of great interest, and on looking through them I cannot discover one which could be fairly regarded as dealing with trivial matters.

The following is a list of the papers :

Jan. 4.—"The Estimation of Insoluble Fatty Acids." By Charles E. Cassal.

Feb. 1.—"The Stock Nitrogen Process: (i.) A Reply to Mr. W. P. Skertchley. (ii.) A Modified Distillation Apparatus." By W. F. Keating Stock.

"On Milk and Milk Products." By H. Droop Richmond.

March 1.—"A Source of Error in the Volumetric Estimation of Chlorides by Silver Nitrate Solution." By W. Gathorne Young.

April 5.—"The Lister Babcock Milk Tester, with some Suggestions for Extending its Use." By G. Embrey.

Mr. J. Baynes showed some analytical appliances of much interest.

May 3.—"Notes from the Aylesbury Dairy Company's Laboratory: (i.) The Action of Heat on Milk. (ii.) Points in the Analysis of Condensed Milk. (iii.) The Adulteration of Milk by Diluted Condensed Milk, and its Detection. (iv.) Points in the Determination of Nitrogen by the Kjeldahl and Stock Processes. (v.) The Boiling Point of Salt Solutions." By H. Droop Richmond and L. K. Boseley.

June 7.—"Sulphuric Acid Hydrolysis of Butter Fat." By Dr. Rideal.

"Notes on Rice Oil and Maize Oil" and "On Rapid Saponification for Analytical Purposes." By Alfred Smetham.

"On Ginger—with Special Reference to Discrimination between Genuine and 'Exhausted' Specimens." By Dr. Bernard Dyer and J. F. H. Gilbard.

"Notes on Centrifugal Milk Testers." By Dr. Vieth.

July 18.—"The Results of the Working of the Sale of Food and Drugs Act in Dublin." By Sir C. A. Cameron, M.D.

- July 18.—“Some Recent Improvements in the Babcock Machine.” By Prof. Tichborne.
- “On Vinegar: its Nature and Manufacture.” By A. H. Allen.
- “Notes on Butter.” By Otto Hehner.
- “On the Detection of Heated Cotton Seed Oil in Lard.” By W. G. Crook.
- “On the Estimation of Chlorine in Certain Waters.” By T. Fairley.
- “Some Simple Appliances for Measuring the Consistency of Semi-Solids; with Note on a New Method of Butter Examination.” By C. E. Sohn.
- Oct. 4.—“On the Examination of Copper Sulphate.” By John Ruffle.
- “Distinction between Iron Pyrites and Oxide of Iron in the Commercial Analysis of Mineral Phosphates.” By H. H. B. Shepherd.
- “On the Discrimination between Genuine Abnormal Milks and Adulterated Milk.” By Mr. H. Droop Richmond.
- Nov. 1.—“Note on an Abnormal Melting Point.” By E. J. Bevan.
- A Discussion took place on the Vinegar Question. Opened by A. H. Allen.
- “On the Estimation of Beef-stearine in Lard.” By W. F. K. Stock.
- Dec. 6.—“An Improvement in Richmond’s Milk Scale.” By Charles E. Cassal and B. Henry Gerrans.
- “Leffmann-Beam Method of Fat Estimation in Milk.” Part III. By H. Droop Richmond and L. K. Boseley.
- “On Vinegar.” By Edward Collens.

Before concluding my brief address I avail myself of the opportunity to thank my friend Dr. Dyer, one of our honorary secretaries, for his kindness and courtesy in keeping me *au courant* with the proceedings and aims of our Society. Living as I do so far from our meeting-place, I fear that Dr. Dyer’s valuable time was often unduly encroached upon by his keeping up so frequent a correspondence with me. His new colleague, Mr. Bevan, will, I am sure, take no umbrage when I say that, although we have the advantage of two secretaries, the most arduous part of the secretarial work has hitherto devolved upon Dr. Dyer. I am glad, however, to find that he has so energetic a colleague in our new secretary, Mr. Bevan.

Gentlemen, our Society has now become firmly established amongst the scientific institutions of these countries. Its members are to be found not only in these islands, but in most parts of our vast colonial empire. We might, indeed, fairly claim to entitle ourselves the British Imperial Society of Analysts. We have done good work in the past, but we have much to accomplish in the future. We share with the medical officers of health the guardianship of the health of the people. As we are the natural enemies of fraud, I trust that our services may be always enlisted on the side of those who strive to establish high standards of purity and quality in the food, drink, and drugs used by the people. For these services the public must surely sooner or later feel grateful, and will not fail to recognise the importance of the rôle of the analyst—they will not deny him the liberal remuneration and social distinctions which so many of the other professions enjoy.

In conclusion, let me avail myself of the occasion to cordially wish our Society and each of its constituents a most prosperous year in 1894.

Mr. Otto Hehner said that the President's address was full of suggestive matter. He did not propose to enter thoroughly into a discussion of the address, although he felt tempted to do so. But there were two or three things which he might touch upon, and one of them was that the experience of those who had practically seen the rise of analytical chemists in this country was very valuable to the younger members of the Society. The brief sketch which Sir Charles Cameron had drawn showed how, barely a generation ago, analytical chemists were almost unknown, while now there were large numbers scattered over the United Kingdom. The competition for the work was great, but new fields opened daily and new problems required solution. Many difficult questions had been more or less settled, but a very large amount of work yet remained to be done, and there was plenty for young chemists to do. The President had referred to what all analysts felt to be a matter of vital importance—the condition of the Food Act in its present form. That Act was looked upon at one time almost with pride, and foreign countries sent emissaries and delegates to study it in England, the place of its birth. It was imitated, and it had been the mother of Food Acts all over the civilized world; but now, when it was almost on the eve of attaining its majority, it was already beginning to exhibit manifest signs of advanced decrepitude; it was so riddled with loopholes that it could barely hold itself together. When he had the honour to occupy the chair in that Society, he had hoped that the time was not far distant—in fact, he thought it had then arrived—when the Act would be subject to proper revision. He thought that public analysts, anxious as they all were to defend the public interests, should be prepared to bring forward a measure which should be better than the Act which was now tottering to its grave. It certainly was not creditable to the country that the Act should be in its present state, and that from want of legislative progress in this direction England should have fallen so far behind other nations. It was a pleasure to him, and a great privilege, to move that the Society accord a cordial vote of thanks to Sir Charles Cameron for his address, and to move that it be printed in *THE ANALYST*.

Mr. Alfred H. Allen said that everyone present had listened with very great interest to the address which Sir Charles Cameron had put before them. Under his presidency the Society had a most successful summer meeting in Dublin, and on that occasion they had presented to them all the lions of the city; and not only had they had an interesting meeting, but that day was followed up by the hospitality of Sir Charles Cameron under circumstances which those present would not readily forget. He fully sympathised with the remarks made by Mr. Hehner as to the necessity of being prepared for the legislation which might be anticipated during next Session of Parliament. The enemies of public analysts were numerous. They had not only to deal with the lawyers, whose professional business it was, as Mr. Hehner had said, to pick holes in Acts of Parliament and get their clients off, however worthy they might be of condemnation, but they had also to deal with the large class of people actually interested in maintaining adulteration and in defeating the machinery of the Acts. Prosecutions frequently failed in consequence of the defence of warranty being

set up, and it should be remembered that Sir Charles Cameron, Bart., M.P., had brought in a Bill in the last Session of Parliament with the express object of making an invoice equivalent to a warranty in all cases. Even at the present time a decision of the High Court laid it down that an invoice of a special kind was to be regarded as a warranty, and that entirely exonerated the retail dealer in the proceedings. Unfortunately, in quarters where analysts could reasonably have expected assistance in carrying out their duties, they met with nothing but rebuffs. There were instances where, unfortunately, the Somerset House chemists had not adopted a mode of doing their duties in a manner which appealed to public analysts. They had, apparently, chiefly in view the protection of questionable trade practices instead of regarding themselves as guardians of the purity of the food supply of the public. The official standards and limits deliberately adopted by the Society of Public Analysts after due consideration should be recognised by law, subject to an appeal to the Privy Council, or some machinery less difficult to set in motion than an Act of Parliament. The Society were by far the fittest body to form opinions as to what the standards of quality of articles of food should be, and on what data they should be judged. He had very much pleasure in seconding the resolution which had been moved by Mr. Hehner.

The motion was carried with acclamation.

OFFICERS AND COUNCIL OF THE SOCIETY OF PUBLIC ANALYSTS FOR 1894.

President—Sir Chas. Cameron, M.D., F.R.C.S.

Vice-Presidents (who have filled the office of President)—M. A. Adams, F.R.C.S.; A. H. Allen; A. Dupré, Ph.D., F.R.S.; Otto Hehner; Alfred Hill, M.D.; J. Muter, Ph.D., M.A., F.R.S.E. (Who have not filled the office of President)—Thomas Stevenson, M.D., F.R.C.P.; Charles E. Cassal; Walter J. Sykes, M.D.

Treasurer—E. W. Voelcker.

Hon. Secretaries—Edward J. Bevan, Bernard Dyer, D.Sc.

Other Members of Council—James Baynes, Sidney Harvey, W. Morgan, Ph.D., W. Cobden Samuel, W. F. Keating Stock, C. R. A. Wright, D.Sc., F.R.S.

The names of those Members of Council whose term of office has not yet expired, and who consequently do not retire this year, are R. Bodmer, W. Chattaway, John Hughes, E. W. T. Jones, H. Droop Richmond, and Alfred Smetham.

THE ANNUAL DINNER.

Immediately after the Annual Meeting the members of the Society and their friends adjourned to the Criterion, where the annual dinner took place. The chair was occupied by the President, Sir Charles Cameron, supported by Captain Verney Cameron, C.B., R.N., Dr. F. Allan, Dr. Abraham, Mr. Otto Hehner, Dr. Muter, Mr. Alfred H. Allen, Dr. Stevenson, Mr. C. E. Cassal, Dr. Alder Wright, Dr. J. A. Voelcker, Mr. J. A. R. Newlands, Mr. B. Newlands, Mr. E. W. Voelcker (Hon. Treasurer), Dr. Bernard Dyer (Hon. Sec.), Mr. Edward J. Bevan (Hon. Sec.), Mr. Aubrey Rake (Solicitor to the Society), etc.

The following toasts were proposed by the President: "The Queen and all the Royal Family;" "The Army, Navy, and Reserve Forces."

Captain Cameron responded for the Navy, and Captain C. E. Cassal and Surgeon-Major Smith for the Army and Reserve Forces.

Dr. F. Allan proposed the toast of "The Society of Public Analysts." The public analyst, he said, was an indispensable official. Some public authorities, apparently, thought that he was only an ornament, and that he was unnecessary. Others looked upon him as a necessary evil that the Local Government Board insisted upon, who should be paid as little as possible, and about whom it was hoped that he would do as little as possible. He fancied that the public knew very little of what a public analyst was, or what his duties consisted in. He thought that if the public and their representatives as a rule knew what public analysts did, the arduous work, and the skill that was required to carry out the intricate processes, they would more highly appreciate his services than was at present the case. The work of the public analyst was becoming more and more intricate as science advanced. As new methods were discovered for detecting adulteration, the adulterator found out new methods for deceiving; he invented more complicated methods of adulteration. It was even asserted, but by suspicious persons, that the cows found methods of getting water into their milk before they were milked. It was high time that the Society should put themselves more prominently before the public. He was sure very few of the public realised the trouble which was required to make an analysis of even the most simple substances, which were so very freely ordered to be analysed. He believed his selection to propose the toast might have arisen from the fact that he was one of the few medical men present who was a public analyst. In coupling the toast with the name of the Society's distinguished President, he could, without the slightest fear of contradiction, congratulate it on having one very specially fitted by nature for the post. He had had the good fortune to serve under him in a body with which they were both connected, and the way in which he performed his duties was one which gained praise and honour on all sides. He was sure that the Society of Public Analysts must be proud to have such a man at their head.

Sir Charles Cameron, on behalf of the Society of Public Analysts, thanked Dr. Allan for the way in which he had proposed the toast. The Society of Public Analysts was a society composed of men who were all earnest in their work, though they were not always very highly paid. He could only say this, that there was no society with whom he felt more enjoyment in mixing than with his colleagues in the Society of Public Analysts.

Dr. C. R. Alder Wright said he felt it was a great honour to be asked to propose the health of the Vice-Presidents of the Society. When he looked back upon the last twenty years, and saw the progress which the Society had made, the difference between the position in which the public analyst now stood and that in which he stood at the earlier period was exceedingly great. This advance was largely due to the Vice-Presidents, many of whom had, in their time, occupied the presidential chair. There were, of course, two kinds of Vice-Presidents—those who had not yet attained to presidential rank and those who had passed it. There were representa-

tives of both on the list before him. It was his good fortune that evening to couple with his toast the names of Dr. Stevenson and Mr. Hehner. As regarded Dr. Stevenson, he need say nothing to commend him to the sympathy of public analysts. They all knew him by his work. Such men promoted the interests of the Society, gradually raised it in dignity, and advanced it so far in the estimation of the public that it might rank with the highest learned society extant. Of Mr. Hehner he need say even less. He was well known, first as an ordinary member, then as a honorary secretary, as a President, and finally as a past and Vice-President. His work spoke for him. He wished to emphasize what he had already said, that the progress which the Society had made was very largely due to his hard and good work in every sense of the term.

Dr. T. Stevenson, in replying to the toast, said that he was very much obliged for the kind manner in which the toast had been drunk, and to Dr. Wright for the exceedingly kindly manner in which he had spoken of the Vice-Presidents and of himself. Although of late years he had taken but very little active part in the Society, yet he could claim that he was one of its founders. He had been associated with it from the first; and, as he looked around, he noticed with melancholy regret the absence of many of his old colleagues among the officers. It was now more than twenty years ago when he, with others, met to found the Society of Public Analysts, a society which had since advanced very much in the estimation of the public, and in that of chemists generally, and this advance was due chiefly to the activity of younger and more active members of the Society. It was always a very great pleasure to him to see his name among those who held office in it; to read the journal of the Society, and to associate himself, so far as his other duties permitted, with the advances of analytical science. Although, as had been said, his own special line lay outside the Society in a great measure, yet he was always very proud to be considered as ranking among those humble people who, while taking very small fees, did excellent work in the service of the public. This Society had done as good work as any other Society of a like standing, and it had a great future before it.

Mr. Otto Hehner said that he would like to add his mite to the remarks which had fallen from Dr. Stevenson at the regret which he felt at the absence of old faces that evening. Some, alas! had gone never to return, but their memories would ever remain fresh in the minds of those who had known them as dear friends. He was, however, glad to see present his old friend Dr. Muter; he regretted the absence of Dr. Dupré, Mr. Adams, and Dr. Hill, but he was sure they were all present in spirit. He remembered when this was a struggling society; he had seen how it gradually grew from youth to adolescence, from adolescence to manhood, and now its position, he was proud to say, was acknowledged even by those who were once its bitterest opponents. He did not mean to say that the fog was even yet altogether dispelled; on the contrary, it still lay over the country. Few people recognized that public analysts did work of the utmost importance. Those who ought to be most grateful to them for safeguarding their interests, ought to be the first to acknowledge that analysts were their protectors and faithful servants. But they did not. He had only quite recently seen in a country newspaper an appeal to public analysts to turn their attention to ascertaining the distinction between the water of the pump and the water

natural to milk, and to leave off harassing honest traders. He also saw the fog, which sometimes came up the Thames Valley, rise over Waterloo Bridge and creep over a certain building close by, and he saw that building and those within it covered by that fog, which seemed to be impenetrable. Still, "hope springs eternal in the human breast," and that hope which had upheld public analysts through the past twenty years would carry them on still further. This was an epoch—the end of a chapter—in the history of the Sale of Food and Drugs Acts. They had had foisted upon them by Act of Parliament a body of referees, with whom they were anxious to work in unison; but, in spite of all their efforts, they had not succeeded. It might in the past have been in some part their own fault—he did not say it had not been; but it had certainly not been entirely their fault that they could not work in harmony with those referees. Although the public might not be aware of the fact, analysts had done a great deal for them. Nor did the various authorities who were the guardians of the public weal recognize adequately the services of the analysts. He knew that an immense amount of work was set before them, and he hoped that they would not cease their efforts, but persevere in the path they had trodden hitherto.

Mr. Alfred H. Allen said he sympathised with and endorsed everything that had been uttered by Mr. Hehner, and he could only say that, as one of the Vice-Presidents of the Society who had passed the chair, he was sorry to think that some of them had been lost to the Society by death and others were absent that evening through circumstances over which they had no control. When he contrasted the small gatherings of eight or ten years ago with the numerously attended dinner of to-day, it showed that the influence and position of the Society of Public Analysts, and the interest taken in the Society, was materially increasing; and if the members would only do justice to themselves, have confidence in their own powers, and stick together, there was no object which they could not achieve. He looked forward to the day when it should not be simply a society banded together by a subscription of a guinea a year, but that it should be the Chartered Society of Public Analysts, officially recognized; that it should have the power—the legalised right—of laying down limits and standards, and possibly methods of analysis, which should be recognized just in the same way that Parliament had for years past legalized the limits of strengths of spirits. Then the Society would be looked up to as the authority—subject, of course, to sanction by the Privy Council or similar body—which should lay down standards and limits and frame definitions. Then there would not be any possibility of a defence being put forward to the effect that beef-fat was necessary in the manufacture of lard, and that malt vinegar was anything which contained malt. Things such as these were public scandals. If public analysts would only stand by each other they would have in the near future the power of settling these matters on a fair foundation, so as to do no injustice to innocent manufacturers and tradesmen or to interfere with harmless trade practices; but, at the same time, they would prevent a great deal of the fraud which went on at the present day, and which caused hundreds of thousands of pounds of loss annually to the people of this kingdom.

Mr. J. Newlands, in a humorous speech, proposed the health of the other officers.

Mr. E. W. Voelcker, in responding, said he felt that he could only express his intention of doing his best for the interests of the Society in endeavouring to fill the place of the late hon. treasurer, Mr. Heaton.

Mr. E. J. Bevan, in returning thanks, said that he felt great difficulty in occupying the position that he did owing to the fact that the late lamented Mr. Davies had filled the office with such complete satisfaction to all the members. He could only hope, in some small degree, to follow in his footsteps.

Dr. Bernard Dyer, in returning thanks, said that he had a message of greeting to give to the Society from Dr. Vieth, who was continuing his labours in milk chemistry at the new dairy station at Hammelin in the Province of Hanover.

Dr. Sykes returned thanks, and gave some statistics regarding the financial aspect of the Journal of the Society.

Dr. John Muter thought he was very lucky in getting the toast he was about to propose assigned to him, because good wine needs no bush; and, when he stated that it was "The Health of the President," he thought he scarcely need say any more. As regarded the presidential duties, of course Sir Charles Cameron, being so much in Ireland, had not been able to attend many of the meetings, but he came over on every important occasion. It was the regret of his life that he was not able to go to Dublin last year, for he understood, from the accounts he had heard, that the members had had a pleasant time.

The President, in replying to the toast, said that he felt most grateful to Dr. Muter for the way in which he had proposed his health and to the members of the Society and the guests for the way in which they had received it. He did feel very proud indeed to be the President of the Society because, as he had already stated in his address that day, although he performed other functions than those of an analyst, yet he had all his lifetime been an analytical chemist. He had also great pleasure in stating that it gave him much gratification to undertake the duty of President.

It had always been a matter of regret to him that more members did not come over to Ireland to attend the meeting of the Society to which Dr. Muter had referred; but he might mention to those who were not present at the annual meeting held that afternoon that he had been asked by another kindred association—the British Medical Association—to deliver the address on public medicine in Bristol; and he hoped that on that occasion the country meeting of this Society would simultaneously take place with the meeting of the British Medical Association; and that the members of the Society would do him the honour of dining with him in Bristol some time towards the end of July. That would be the way in which he would feel most grateful to the members of the Society—to make the next summer meeting as successful a meeting as the one which he had the pleasure of welcoming in July last.

Dr. J. A. Voelcker proposed the toast of "The Visitors," which was responded to by Messrs. B. J. Newlands, Dr. Phineas Abraham, and Dr. James.

Messrs. Septimus Marsland and Walter Fletcher favoured the company with

songs, and several solos were very tastefully rendered on the violoncello by Herr. von Mulder. The musical arrangements were under the direction of Mr. Alfred Smythson.

THE LEFFMANN-BEAM METHOD FOR FAT-ESTIMATION IN MILK. PART III.*

By H. DROOP RICHMOND AND L. KIDGELL BOSELEY.

(Read at the Meeting December 6, 1893.)

In a previous paper (Part I.) one of us suggested that differences between the results obtained by Leffmann and Beam, by Hehner, and by himself were due to diversity in the amount of acid added, the strength of the acid, and differences in the fusel-oil.

Influence of Fusel-Oil.—Five samples of fusel-oil were obtained from different sources; the smell and colour when mixed with hydrochloric acid varied considerably. A milk was taken which gave 3·66 per cent. fat by the Adams method, and Leffmann and Beam determinations were made in triplicate, using bottles for which various factors had to be used to correct scale readings into actual percentages.

No. of Expt.				101	102	103	104	105
Fusel-Oil	...	...	...	A	B	C	D	E
Fat by Leffmann and Beam	1.			3·70	3·62	3·72	3·60	3·62
"	"	"	2.	3·70	3·65	lost.	3·60	3·60
"	"	"	3.	3·73	3·63	3·73	3·61	3·62
Average	...	...	...	3·71	3·63	3·72	3·60	3·61
Number of revolutions re- quired to produce complete separation				200	100	250	100	100

These results show that there is a slight difference in various samples of fusel-oil amounting to 0·1 per cent., and also that results are concordant to 0·03 per cent. It is not necessary to multiply these results, but we have several times found the same difference in other experiments. The fusel-oil we use generally is E, and this has a specific rotation $[\alpha]_D$ of $1\cdot7^\circ$, and therefore contains about 30 per cent. of the active amyl alcohol. We thought it possible that by the continued action of hydrochloric acid on the amyl alcohol, that amyl chloride, and possibly di-amyl ether (cf. Rogers, *Journ. Chem. Soc.*, lxiii, 1160) might be formed, and that these might influence the results; we find no evidence of this being the case, as freshly-prepared "fusel mixture" gives results which are identical with a "fusel mixture" prepared for some months. A slight error may be introduced by the use of different fusel-oils, but a few preliminary experiments with each lot of fusel-oil will soon settle the question.

Influence of the Strength of Acid Used.—Embrey (*ANALYST*, xviii., 118) has pointed out that in a somewhat analogous process it is very important to work with a fixed strength of acid; he does not show that the results are influenced otherwise than by a discoloration of the fat by strong acid.

* Part I., *Analyst*, xvii., 144; Part II., *Analyst*, xviii., 130.

We have taken milks and made estimations with five differing strengths of acid with the following results :

	Adams ...	6.10	3.93	3.53	3.49
106.	98.3% acid	6.07	4.00	3.60	3.52
107.	96.8 „	5.89	—	—	—
108.	96.1 „	5.90	—	—	—
109.	95.3 „	5.92	—	—	—
110.	93.9 „	5.76	3.77	3.37	3.30

The Leffmann-Beam results are here the readings of the scale, and are not multiplied by a factor for correction.

With the strongest acid at the ordinary temperature (about 20° C.), the fat was so dark as to be hardly readable when the whole of the acid was added at once ; by cooling the acid and milk down to 5° C., or by adding the acid more gradually, the fat came up in a clear light-coloured layer, and could be easily read ; no difference in the results was, however, obtained ; we have obtained a large number of results pointing to the same differences by varying the strength of acid. The strengths 98.3 and 93.9 are about the extreme variations for acid sold as “pure” ; in the previous parts of this paper these extreme strengths were not used, and consequently the very small differences with varying strengths were not detected. No practical inconvenience is felt from the differences with varying strengths of acid, as a few preliminary experiments with each lot of acid and fusel-oil will give the necessary factor to be applied to the bottles to read correct percentages.

It is advisable to test the strength of the acid before use. For this there are five different methods :

- (1) Estimation of the sulphion (SO_4) by precipitation as BaSO_4 .
- (2) Estimation of the acidity by titration.
- (3) Conversion into ammonium sulphate, and weighing as such.
- (4) Deducing the strength from the density at 15° C. (cf. Pickering, *Journ. Chem. Soc.*, lvii., 331, *et seq.*).
- (5) Deducing the strength from the freezing-point.

If the acid is nearly pure, the density determination is by far the most convenient and exact. One of us has published a table for the calculation of percentages (*J.S.C.I.*, 1890, No. 5), but it has the disadvantage of not being applicable to acids of about 97 per cent. strength ; it is necessary to dilute these with 3 to 5 per cent. water (or ice) ; impurities in the acid may make an appreciable difference.

We do not recommend the titration of the acid, as the error of titration is rather large unless done under special conditions, and standard solutions of alkali may be inaccurate to 1 per cent. of their absolute value, unless carefully corrected for temperature and accurately standardized.

The estimation as sulphion, of course, will return as sulphuric acid all sulphates present as impurities. The determination of the freezing-point requires some skill, but in the hands of experienced observers yields very accurate results ; the temperature of freezing of ordinary strengths of acids are so low as to render this method generally troublesome.

The conversion into ammonium sulphate is very convenient, but neutral sulphate of ammonium is never obtained, the residue is always acid to methyl orange ; if the

acidity be determined by titration and a correction made, the residue ignited and the non-volatile matter weighed, this method gives results which are approximately correct. By estimating the residue upon ignition of the acid and subtracting twice its quantity from the acid deduced from the density, a fair approximation of the strength can be made.

We are in the habit of using the $(\text{NH}_4)_2\text{SO}_4$ method and the density determination, and the corrected results are not very far apart.

Influence of Time and Speed of Whirling.—Variation in the time of whirling from one half to three minutes produced absolutely no change. Variations in the speed from 700 revolutions per minute to 2,000 produced no change. It is very unlikely, then, that any fat should be held in suspension,* as in that case variations in time and speed of whirling would then show differences.

Influence of Temperature.—Dr. Voelcker suggested to us that temperature would make a difference in the results; it does in this respect, that if the milk and acid are at a high temperature when mixed with the higher strengths of acid, the fat is liable to be dark in colour, and is difficult to read. We have very few specific results as to the influence of temperature, but as we find that these tend to show that there is no appreciable difference, and we find that on hot or cold days the Leffmann-Beam results agree equally well with the Adams determinations, we do not attach much importance to this.

We give a table of results obtained; in many cases a weak acid has been employed as low as 93 per cent. H_2SO_4 , and the factor for the acid and fusel-oil has been in these cases calculated from a few preliminary experiments; in others the bottles have read directly the percentages of fat, a stronger acid having been used.

In correcting for errors in graduation of bottles we always multiply by a factor and never add a constant; if the error is simply due to incorrect graduation, the equation calculated from the results for the relation between Adams (A) and Leffmann-Beam (B) should be $A = xB + O$. Were the fat incompletely thrown up, the equation would then become $A = xB + K$, K being the amount of fat retained. We have taken four of our series, and calculated the equation connecting Adams and Leffmann-Beam, by making every pair of results into a simultaneous equation and combining the solutions; we have also calculated the probable error in the constant K. These are:

1. $A = 1.096B - .04 \pm .04$
2. $A = 0.940B - .02 \pm .03$
3. $A = 0.991B + .01 \pm .03$
4. $A = 1.012B - .03 \pm .03$

In each case it is seen that the constant (K) does not exceed the probable error, and it is therefore practically nothing. We have thus experimental proof that no fat is retained in solution, and that the errors of graduation may be compensated by multiplying by a factor.

In order to throw more light on the rôle played by the fusel-oil in the Leffmann-Beam process, we have found it of assistance to compare the results obtained by a

* We find that we obtain the same result on adding the "fusel mixture" after the acid, as when the "fusel mixture" is added first.

process analogous to the Leffmann-Beam with the fusel-oil omitted—the Babcock process.

This has been lately treated of by Stokes, Shutt, Embrey, Babcock, and Tichborne, and our labour in finding suitable results has been greatly increased by the fact that each of these observers to a notable extent contradicts the conclusions of the others. Out of the mass of information we are enabled to pick out thirteen results by Embrey from which we can calculate a relation between Adams and Babcock. Tichborne gives in a footnote some data from which another relation can also be calculated. These are :

$$\text{Embrey } A = \frac{B}{1.013} + .35 \pm .04$$

$$\text{Tichborne } A = \frac{B}{1.11} + .45$$

These two equations only agree in one point, *i.e.*, in showing that there is fat retained by the acid mixture, a conclusion reached independently by Stokes.

It is a well-known fact that when sugar, sulphuric acid, and fat are mixed, combination takes place, with the formation of a compound of red colour. This red colour is noticed when milk and sulphuric acid are mixed. It is an equally well-known fact that when amyl alcohol is substituted for the fat, a compound of a reddish-violet colour is formed. This we always notice in the Leffmann-Beam process.

We hardly venture to form a theory that the retention of fat in the Babcock process is due to the formation of the red compound, but we think we are quite safe in saying that in the Leffmann-Beam process the fusel-oil itself would combine with the acid and sugar before the fat is attacked, and thus the whole of the fat is available for estimation.

The tendency for the fat to enter into combination will be much less in the Leffmann-Beam process than in the Babcock, seeing that in the former the final mixture contains barely 50 per cent. H_2SO_4 ; while in the latter the strength exceeds 64 per cent. H_2SO_4 , and it is kept at a high temperature by the boiling water. That the formation of a compound containing a part of the fat is probably not the whole explanation is shown by the fact that Embrey and Tichborne obtain results showing relations between the Adams and Babcock which are not in accordance, while neither of these relations expresses the results of Stokes and Shutt; while Tichborne confesses that the Babcock is full of hidden errors. In justification of the error of the Babcock process, Embrey has pleaded that his inaccuracies are the results of the bottles being graduated to show the percentages of butter that can be obtained from the milk, and not the percentages of fat; as this statement is at direct variance with that of the inventor of the method, who says, "The test is designed to show the amount of pure butter-fat in the milk, and not the butter which will be made from it," we have ignored Embrey's statement, and have based the relation we have calculated from his results on the assumption that Babcock's statement is the more reliable.

We have deliberately come to the conclusion that it is to the use of fusel-oil that the Leffmann-Beam method owes its marked superiority. The many objections, which seem so apparent to patentees of other methods that they think it unnecessary

to detail them, we have not only been unable after long investigation to discover, but we find them to be, in mathematical language, negative quantities.

We would like to state, lest any purchaser of Leffmann-Beam machines may be afraid to use them on account of Embrey's statements "that they are dangerous, and that it is desirable to cover them in (presumably with a light tin case), because the cups, which are very liable to come off, would be driven through the operator's body," that we have not heard of any accident from this cause, and that in the many hundreds of experiments we have made, nothing untoward has occurred. We do not, however, think that Mr. Embrey meant this part of his paper to be taken seriously, as the absurdity of putting a light tin case as a protection against a projectile of sufficient force to penetrate the body of a human being is manifest to all.

We wish to emphatically state that the Leffmann-Beam method is quite unsuitable to be placed in the hands of inexperienced persons, though in scientific hands it is capable of great accuracy.

We have endeavoured to study one by one the errors of this method, and to show the means of correcting them. That we have been entirely successful we can hardly hope, but as a long experience has failed to reveal other serious errors, we think that those that have escaped our notice are not important. We hope to find time to study the Babcock method, and to see whether the errors mentioned by Tichborne, and shown by the results of other observers, are inherent or adventitious.

SUMMARY OF CONCLUSIONS.

1. As variations in the sulphuric acid and fusel-oil may slightly influence the result, it is well to obtain large quantities of these at a time, and by a few preliminary experiments fix the factor necessary to convert scale-readings into percentages of fat.

2. It is advisable to use the same strength of acid (94-96 per cent. H_2SO_4 is convenient). This is best estimated by converting a known quantity into ammonium sulphate, drying at 100°C ., and weighing; titrating the acidity with $\frac{N}{10}$ baryta solution, using methyl orange as indicator, and then igniting, and weighing the non-volatile matter (correcting for the barium sulphate formed); or by deducing the strength from the density (hydrometers are rarely of sufficient accuracy, and a picnometer should be used), and correcting by subtracting twice the weight of the non-volatile matter.

3. If it be necessary to perform the experiment when the atmospheric temperature is high, the milk and acid should be cooled beforehand, or should this not be practicable, the acid should be added in small portions (2 c.c.) at a time, and the bottle shaken between each addition, or a weaker acid may be used.

4. About half to three quarters of a minute's revolution at the rate of from 1,200 to 1,500 revolutions a minute has been found the most convenient in practice. The machine has not been found dangerous at this speed; but, if wished, a longer period of revolution at a slower speed is equally efficacious.

SUGGESTIONS FOR PRACTICAL USE.

This method must not be used for accurate work unless the bottles, using the same acid and fusel-oil as are designed for general use, are standardized against the Adams, or other reliable method. If this be done the results can be relied upon to

0.15 per cent., and are nearly always accurate to 0.1 per cent. It can thus be used for milk control by a skilled operator.

A six-bottle machine is large enough for the most extensive laboratories, as with this 30—50 samples an hour, according to the energy of the operator, can be examined.

The total solids and solids not fat can be calculated therefrom by the milk-scale or Hehner and Richmond's formula, *provided the density of the milk be not taken until after an expiration of twelve hours from the time of milking*. Before this time Recknagel's phenomenon is not complete, and calculation of the total solids may lead to serious errors. It is quite useless to recommend this, or any other rapid method of fat estimation, combined with any tables for calculating total solids, to farmers, as they will only be led into error if they attempt to do any more than estimate the fat. The very doubtful value that a knowledge of the amount of solids-not-fat might have to cheesemakers, is also reduced to nothing.

The proper sphere of this method is the laboratory, and for public analysts for sorting their milks, and for chemists engaged in milk control it leaves nothing to be desired.

TABLE OF RESULTS OBTAINED.

No. of Expt.	Adams.	Leffmann and Beam.	Error.
111. ...	3.80	3.80—3.80 ...	—
112. ...	3.58	3.55 ...	— .03
113. ...	3.71	3.75—3.70 ...	—
114. ...	3.61	3.57 ...	— .06
115. ...	3.70	3.72 ...	+ .02
116. ...	2.79	2.77 ...	— .02
117. ...	3.40	3.40 ...	—
118. ...	2.38	2.30 ...	— .08
119. ...	2.60	2.60 ...	—
120. ...	1.44	1.45 ..	+ .01
121. ...	6.21	6.15 ...	— .06
122. ...	3.67	3.65 ...	— .02
123. ...	3.77	3.65 ...	— .12
124. ...	2.32	2.30 ...	— .02
125. ...	2.93	2.80 ...	— .13
126. ...	3.40	3.35 ...	— .05
127. ...	3.44	3.45 ...	+ .01
128. ...	3.21	3.22 ...	+ .01
129. ...	3.19	3.20 ...	+ .01
130. ...	1.87	1.90 ...	+ .03
131. ...	2.65	2.66 ...	+ .01
132. ...	3.00	3.15 ...	+ .15
133. ...	2.99	3.00 ...	+ .01
134. ...	3.51	3.40 ...	— .11
135. ...	3.64	3.55 ...	— .09
136. ...	2.82	2.72 ...	— .10
137. ...	2.72	2.75 ...	+ .03
138. ...	3.50	3.50 ...	—
139. ...	3.53	3.47 ...	— .06
140. ...	3.31	3.30 ...	— .01
141. ...	3.51	3.45 ...	— .06

No. of Expt.	Adams.	Leffmann and Beam.	Error.
142. ...	3.52	3.50	-.02
143. ...	2.26	2.20	-.06
144. ...	1.60	1.50	-.10
145. ...	3.66	3.61	-.05
146. ...	.40	.38	-.02
147. ...	3.86	3.92	+.06
148. ...	4.00	3.97	-.03
149. ...	3.66	3.66	—
150. ...	6.14	6.16	+.02
151. ...	6.10	6.22	+.12
152. ...	4.48	4.46	-.02
153. ...	3.90	4.00	+.10
154. ...	3.64	3.67	+.03
155. ...	3.59	3.63	+.04

APPENDIX.

TABLE FOR DEDUCING THE STRENGTH OF SULPHURIC ACID FROM THE DENSITY.

*(Extracted from the Journ. Soc. Chem. Ind.)**Density at 15° C. (Water at 15° C. = 1.)*

Density.	Percentage of Acid.	Density.	Percentage of Acid.
1.8384 ...	100.00	1.8385 ...	94.38
1.8404 ...	99.50	1.8380 ...	94.20
1.8418 ...	98.98	1.8375 ...	94.03
1.8430 ...	98.08	1.8370 ...	93.87
1.8432 (maximum)...	97.50	1.8365 ...	93.71
1.8430 ...	96.93	1.8360 ...	93.56
1.8425 ...	96.39	1.8355 ...	93.41
1.8420 ...	96.02	1.8350 ...	93.26
1.8415 ...	95.67	1.8345 ...	93.12
1.8410 ...	95.40	1.8340 ...	92.98
1.8405 ...	95.16	1.8330 ...	92.71
1.8400 ...	94.96	1.8320 ...	92.46
1.8395 ...	94.77	1.8310 ...	92.22
1.8390 ...	94.57		

This method is most unfitted to place in unscientific hands. Even more so is the Babcock process.

DISCUSSION.

Mr. E. J. Bevan said it appeared to him that the authors had gone somewhat too minutely into detail, seeing that they admitted the possible error to be 0.15 per cent. Nevertheless, the paper was full of very useful hints, and it cleared up several points which he had noticed during the use of the process, and he thought it was a very welcome addition to analytical literature. With regard to the danger of the apparatus, he could plead guilty to putting up a thick iron screen himself. When in Dr. Muter's laboratory that gentleman had recommended him to be on the safe side.

Mr. Burford stated that in using the HCl mixture four months old he had obtained precisely the same results as when using the mixture freshly prepared. He also gave his experience of using the small machine, and in obtaining various readings, and referred to the difficulty he found in weather like the present in consequence of the fat actually congealing in the morning before he could read it. What he had to

do finally, was to put the bottles in a vessel of warm water and keep them in that temperature until he could get a reading. It seemed to him that some definite method for reading was desirable. He would like to make a remark with regard to the mixture of diluted acid, the instructions given with the machine of 1 acid to 2 of water, hot mixture, being very vague. At the moment of mixing 105° C. was registered, but if left it would fall below 60° . If they had a temperature so variable as that, something more definite in the directions was needed.

Mr. Cassal said that the machines ought only to be used by trained chemists. It was absolutely absurd to suggest that dairymaids, ploughmen, and persons of similar attainments were capable of dealing with the difficulties which might arise in the use of analytical machines, and in drawing conclusions from the results obtained with them. To suggest that people of this sort should manipulate with sulphuric acid and amyl alcohol, and attempt to draw deductions from the ceremonies they went through, was ludicrous. He was glad Mr. Richmond and Mr. Boseley had put this matter again into definite shape, as he (Mr. Cassal) had done on a previous occasion, and he hoped they would hear no more in that Society about such machines being suitable for use by the untrained and the ignorant.

Mr. Richmond said he always used the acid-mixture for filling up the bottles cold, and kept it in a bottle fitted with a siphon and pinchcock, containing half a litre. He had not found the least appreciable difference between using cold acid or hot. It so happened that his laboratory was always warm, and he had not been inconvenienced by cold days, but he could quite understand that if it were too cold it would be necessary to warm the whole bottle up again. With regard to the temperature for reading, as far as his experience had gone he had not found any trouble. The first, second, third, fourth, or even fifth readings gave exactly the same results. He thought there was a possible explanation why the readings had decreased; that it was not so much due to contraction of fat in cold weather in the neck of the bottle as to the fact that the fat on cooling adhered to the sides, and could not be properly read. It was always better in his opinion to take too much trouble to find out whether there were errors than to take too little trouble. The time was not wasted, even if there were no tangible results. With regard to the danger of the Leffmann-Beam process, he might say that when the apparatus was going full speed he accidentally put his arm right into it and stopped it, and no material injury resulted. He did not think it was a very dangerous process, but Mr. Bevan was no doubt right in thinking it best to be on the safe side.

The Addition of Phenolphthalein to Margarine. F. Hart. (*Chem. Zeit.*, 1893, xvii., 1908-1909.)—Soxhlet has proposed, in order to check the adulteration of butter with margarine, which is still extensively practised, that the addition of a small quantity of phenolphthalein to all margarine shall be made compulsory. In opposition to this proposal it has been stated that margarine thus treated becomes uneatable within eight days of its preparation. Experiments at the dairy station at Prenzlau show that such is not the case. The author has therefore endeavoured to ascertain whether any toxic effect can be ascribed to the small quantity of phenolphthalein which it would be necessary to add.

Portions of margarine weighing 50 grammes each were intimately mixed with 2, 4 and 6 milligrammes of phenolphthalein and exposed to the air and light for six weeks, at the end of which time no perceptible alteration in their quality could be detected, and all were perfectly edible. That the phenolphthalein was still capable of serving as a means for the detection of margarine was proved by treating each sample with caustic soda, when a red colour was unfailingly produced. The author then took doses of phenolphthalein, rising from 1 to 20 centigrammes, without experiencing any ill effects. On raising the dose to 0.3 gramme he suffered from diarrhoea, which became more severe when the quantity exhibited was increased to 0.5 gramme. When taken in quantities such as these, phenolphthalein had an unpleasant, bitter taste. Assuming that the quantity proposed by Soxhlet, namely 2.2 grammes per centner of margarine, were used, a toxic dose of phenolphthalein would be contained in 13.6 pounds of margarine. The author strongly advocates the adoption of the regulation.

B. B.

The Use of the Cryoscopic Method for the Examination of Butter. F. Garelli and L. Carcano. (*Staz. sperim. agrar. ital.*, 1893, xxv., 77, through *Chem. Zeit.*)—The authors, having the fact in view that the glycerides present in butter have a lower mean molecular weight than those existing in margarine, have applied the cryoscopic method, now commonly in use for the determination of the molecular weights of substances that cannot be volatilised without decomposition, to the detection of margarine in butter. Using the Beckman apparatus with benzene as a solvent, they have found the constant for the molecular depression to have the value 53. Adopting this figure, pure butter has a mean molecular weight of 696 to 716, while that of margarine ranges from 780 to 883. The method, like most of those at present in use, is only available for the detection of fairly considerable additions of margarine.

B. B.

NOTE BY ABTRACTOR.—This method, though ingenious, is merely an apotheosis of the ordinary determination of the saponification equivalent.

Determination of Free Acid in Solutions of the Salts of the Heavy Metals. F. Hoffmann. (*Chem. Zeit.*, 1893, xvii., 1318, 1319.)—Free acid can easily be determined in solutions of the salts of alkalies and alkaline earths by titration with an alkali, using a suitable indicator, but this method cannot be adopted for solutions of the salts of the heavy metals, as they have an acid reaction even when containing no free acid. The necessity of determining free acid under these conditions becomes especially apparent when solutions of salts that have been used as electrolytes are examined to ascertain what alteration in their acidity has occurred during the passage of the current. Existing methods are comprised under the following heads:

- (1) Titration with alkali until a precipitate appears.
- (2) Titration with alkali, using congo-red paper as an indicator.
- (3) Evaporation of the solution and extraction of the free acid with absolute alcohol.
- (4) Titration with a standard ammoniacal copper solution.
- (5) Determination of the metal and of the total acid, and calculation of the amount of acid corresponding to the metal; the difference between the acid thus calculated and the total acidity giving the quantity existing free.

The method to be described below was devised by the author for ascertaining the acidity of the electrolyte in a copper refinery, and possesses advantages over those quoted above.

When excess of potassium ferrocyanide is added to a solution of copper sulphate containing free acid, copper ferrocyanide is thrown down equivalent to the amount of neutral copper sulphate, and hydroferrocyanic acid equivalent to the free acid originally present is liberated. The only condition necessary to be observed in order to convert this into a quantitative method is that the dilution of the solution shall be sufficient to prevent the decomposition of the hydroferrocyanic acid. The details of the method are as follows: A known quantity of the solution, containing 2 to 3 grammes of copper sulphate, is treated with excess of 2.5 per cent. solution of potassium ferrocyanide, made up to a litre, shaken, allowed to stand, and 100 to 250 c.c. of the clear liquor (according to its acidity) drawn off and titrated with $\frac{N}{10}$ caustic soda solution, phenolphthalein being used as an indicator. The solution of potassium ferrocyanide should be well protected from light, and in adding it to the copper sulphate solution care should be taken to prevent any portion of the turbidity that forms in it finding its way into the precipitating vessel, as the settling of the copper ferrocyanide is hindered thereby. A similar inconvenience arises from the use of a large excess of potassium ferrocyanide. The presence of sufficient ferrocyanide can be recognised by utilizing the property of ferric sulphocyanide of dissolving in ether, which is effected thus: A drop of *neutral* potassium sulphocyanide is added to the liquid to be tested—which, in the case of commercial electrolytes, always contains enough iron for the purpose of the test—and the whole shaken out with ether, which is no longer coloured red, when all the iron exists as ferrocyanide instead of sulphocyanide. Seeing that in a mixed solution of copper and iron salts the former is precipitated first by potassium ferrocyanide, the absence of iron is a proof of the presence of an excess of the precipitant.

As all the heavy metals are precipitable by potassium ferrocyanide, the method is generally applicable for the determination of free acid in solutions of their salts. It is much simplified when used for the salts of metals, which give white precipitates with potassium ferrocyanide, *e.g.*, lead, silver, and zinc. In this case no filtration or decantation is requisite, for the turbid liquid can be titrated directly. Small quantities of "ous" salts, such as ferrous sulphate, do not greatly affect the results, but the method cannot be used when such salts are present in quantity. B. B.

REVIEWS.

MANURES AND MANURING. By C. M. AIKMAN, M.A., B.Sc., F.R.S.E. (William Blackwood and Sons.)

This is a valuable handbook, exhibiting, throughout, the work of a conscientious and painstaking writer, well up in the contemporary agricultural chemistry of Germany and France as well as that of our own country. We had the pleasure some

time since of noticing an "advance" portion of this treatise, published under the title of "Farmyard Manure." The complete work, which is now before us, is written on the same lines, and does not belie the promise of the preceding fragment. The work is, throughout, lightened for the general reader by the relegation to appendices of statistical and tabular matter, reference to which is facilitated by note marks in the general text. The aim of the author has been to provide a text-book on manures midway, in the scope of its treatment, between Professor Storer's elaborate treatise and the smaller and more popular manuals, and he must be admitted to have carried out his by no means easily effected task with a near approach to satisfaction. Mr. Aikman has had, during a number of years past, an exceptional experience as a lecturer on agricultural chemistry, not merely in the comparatively easy work of the class-room, where regular students imbibe their knowledge systematically, but also in the much more difficult work of expounding its doctrines to "popular" or unscientific audiences in isolated and disjointed discourses. This experience lends probability of fulfilment to the hope expressed by himself that the work now under notice may be of especial value to those engaged in teaching agricultural science. At all events, no agricultural teachers or practitioners of agricultural chemistry should fail to provide themselves with it.

JOHNSTON'S ELEMENTS OF AGRICULTURAL CHEMISTRY. From the edition by Sir CHARLES A. CAMERON, M.D. Revised and in great part re-written by C. M. AIKMAN, M.A., B.Sc., F.R.S.E. (W. Blackwood and Sons.)

Mr. Aikman, whose original work on manures we have noticed in the foregoing paragraph, is indefatigably industrious. Simultaneously with the publication of his own volume there issues from the press this new edition—the seventeenth—of one of the most popular technical treatises known to agricultural science. It is thirteen years since Sir Charles Cameron revised and brought up to date the excellent and once unique work of Professor Johnston, and during these thirteen years the rapid progress of agricultural chemistry has rendered even "Johnston and Cameron," as it is familiarly called, an old-fashioned book, that has been calling out with increasing stress for further revision. This revision has been very fairly accomplished by Mr. Aikman, and as the demand for so time-honoured a text-book is sure to be sustained even in the face of many new ones, agricultural students will be grateful to him for his labours. In these pages it is pleasant to note that while the book remains, and must always remain, associated with the name of its earlier editor, Sir Charles Cameron, the present President of the Society of Public Analysts, the present edition is dedicated by its new editor to one of the present honorary secretaries of that society.

PRINCIPLES AND PRACTICE OF AGRICULTURAL ANALYSIS. By HARVEY W. WILEY, Chemist to the U.S. Department of Agriculture. (The Chemical Publishing Company, Easton, Pa., U.S.)

Professor Wiley's name is so well known in connection with the scientific investigations conducted over a large continent under the superintendence, direct or indirect, of a very active and well-organized Government Department, that anything emanating from his pen cannot fail to arouse interest and to command attention. The work under notice is the first monthly part of what promises to be a very comprehensive manual of agricultural chemistry for the use of analysts, teachers and students. The author hopes to complete the work in twenty-four monthly parts at twenty-five cents each, but this may not prove to be possible. The first part, which begins the subject of soils, contains some excellent plates showing the microscopic structure of various rocks.